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SUBSTANCES

Memorandum

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SUBJECT: Initial Grape Benefits Assessment for Azinphos-methyl and Phosmet

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SUMMARY

California

Grape growers using phosmet in California, and using phosmet and azinphos-methyl in the Midwest and North Central Regions of the U.S., will be adversely impacted if the restricted entry interval (REI) for either or both of these chemicals is extended longer than 14 days. The current REI is 2 days for phosmet and 21 days for azinphos-methyl. In California, where 90% of grape production occurs, phosmet's critical use is for late season control of omnivorous leafroller, primarily in Fresno County. Although the use of phosmet is not extensive in California on grapes (2% of California grape acreage treated with phosmet annually), the grape growers that are currently using phosmet could suffer a decline in revenues of as much as 7% from current net revenues, due to the increased cost of the alternatives to phosmet for omnivorous leafroller control. Primarily due to the limited use of phosmet statewide, total state revenues will decline less than 1% from current state net revenues.

North Central and Midwest Regions

In the North Central and Midwest Regions, phosmet and azinphos-methyl are critical for the control of grape berry moth, a primary pest in both regions. Phosmet's critical use is late season due to its shorter PHI, and azinphos-methyl is critical for mid-season grape berry moth control. In both regions, extending azinphos-methyl's REI to longer than 14 days will result in growers no longer using the chemical in favor of more costly chemicals with shorter REIs, so that growers can achieve control of grape berry moth and still carry out critical activities, such as irrigation. In both regions, due to increases in the chemical cost of mid-season control of grape berry moth, grower net revenue could decline as much as 10% from current grower net revenues, and regional net revenues could decline 1% from current regional net revenues.

Extending the phosmet REI on grapes to more than 14 days will not allow growers to use phosmet and still achieve adequate control of grape berry moth and begin hand harvesting activities. Growers will not use phosmet, and will have to use less effective and more costly chemical control for grape berry moth, resulting in losses in yield and increases in costs. Grower net revenues in both regions could decline as much as 2 times current grower net revenues. At the regional level, net revenues in the North Central Region could decline as much as 17% from current regional net revenues, and in the Midwest Region, regional net revenues could decline as much as 1 1/4 times current regional net revenues.

If both the phosmet REI and the azinphos-methyl REI is extended beyond 14 days, growers will not use either phosmet or azinphos-methyl, and could face yield losses and increases in costs from having to use less effective and more costly chemicals for the control of grape berry moth. Grower net revenues could be reduced by as much as 2 1/4 times current grower net revenues in both regions. At the regional level, net revenues could be reduced by as much as 20% from current regional net revenues in the North Central Region, and 1 ½ times current regional net revenues in the Midwest Region.

Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

BACKGROUND

Grapes belong to the Vitaceae family. There are over 100 species in the literature, and many more varieties. A versatile crop plant, the fruit may be fermented to wines and brandy, or it may be eaten fresh, or dried into raisins. A common use in the United States is for unfermented juice.

Grape Cultural Practices

When temperatures are 50°F or below, grapevines go into their dormant season. Vines are pruned and canes are ties to trellis wires just prior to spring. As temperatures begin to warm above 50°F, the plants enter bud swell, in which green leaves are beginning to show. This is followed by bud break, followed by pre-bloom then bloom. After bloom, is shatter, in which the unfertilized berries fall from the clusters. Then is first cover which is the vegetative growth after berry set. Next is veraison, the ripening of the berries, followed by harvest and hardening off.

All grapes, wine, table, juice, and raisin, go through this cycle. However, the different varieties dictate the length of time spent in each stage (some varieties mature in 90 days, others in 190 days). Also, when these phases occur depend upon the weather, therefore, grapes get an earlier start in the South and may be 4-6 weeks ahead of the North. Most of the insect information is correlated to the stage of the grapevine, therefore, discussions will be related to the stage of the grapevine.

Grapes are a hand labor intensive crop. In general, workers would be pruning and tying vines in the dormant season, generally from mid-December through February. From May through June, the workers are pulling leaves to increase air circulation. From mid-June through mid-July, workers are thinning bundles to regulate the crop. In August, defective (mostly diseased) bundles are selectively removed. Harvesting begins in mid-August and goes into October. Wine and table grapes are hand harvested and grapes for processing are often mechanically harvested.

U.S. and Regional Grape Production

Table 1 lists the U.S. Regions that account for 99% of the U.S. production of grapes and the major states in these regions. Total U.S. grape production averages 6 million tons per year, and is valued at $2.8 billion. The major production region is California, which accounts for 90% of the U.S. production of grapes, followed by the North Central and Northwest regions, respectively. No state, other than California, accounts for more than 4% of the U.S. production of grapes.

Table 1. Grape Production and the Value of Production in the U.S. by Region and Major States in each Region [1, 2]

Region/State [3]	Bearing Acreage (Acres)	Production (1000 tons)	Percent of U.S. Production	Percent of Region Production	Value of Production ($1000)
U.S.	880,400	6,025	–	–	$2,783,615
North Central Region	56,300	317	5%	–	$92,924
New York	31,500	165	3%	52%	$48,625
Michigan	12,000	73	1%	23%	$20,466
Pennsylvania	12,800	71	1%	22%	$19,457
Midwest Region [4]	3,400	12	<1%	–	$4,734
Northwest Region	45,900	260	4%	–	$130,146
Washington	39,000	244	4%	94%	$109,838
Oregon	7,000	16	<1%	6%	$20,308
California	766,500	5,416	90%		$2,536,202

1. Source: USDA/NASS Noncitrus Fruits and Nuts 2000 Preliminary Summary.
2. Production includes all grapes.
3. Other grape producing states include: Arizona, Georgia, Missouri, North Carolina, and South Carolina.
4. The grape producing states comprising the Midwest Region include: Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Nebraska, Ohio, and West Virginia. Production data published for Arkansas and Ohio.

USE OF AZINPHOS-METHYL AND PHOSMET

Target Insect Pests

California

In California, azinphos-methyl is applied to less than 1% of the grape acreage, and is not considered an important pest control tool. For phosmet in California, the primary target pests are the omnivorous leafroller and the grape leaf skeletonizer. The secondary pest complex for phosmet is composed of the grape mealybug and the newly introduced, vine mealybug. The vine mealybug has limited distribution, mostly in the Central Valley.

Omnivorous Leafroller (OLR)

The omnivorous leafroller (OLR) is a moth whose larval stage can cause serious damage in the Northern and Southern San Joaquin Valley regions. It is a major pest of grapes in this area. It feeds on leaves, flowers, and developing berries. Damage to post-veraison berries allows rot organisms to enter the fruit. OLR larvae overwinter in old grape clusters (mummies) and vineyard weeds. In spring, the larvae complete their development and moths emerge and lay shingle-like egg masses on grape leaves. After about 5 days these eggs hatch, and larvae web together leaves or cluster parts to form a nest in which they feed.

Western Grape Leaf Skeletonizer (WGLS)

Western grape leaf skeletonizer larvae feed gregariously on lower leaf surfaces, leaving only the veins and upper cuticle, and giving damaged leaves a whitish paper-like appearance. Maturing larvae completely remove all interveinal tissue, leaving only the larger veins. When abundant, larvae can defoliate vines. If there is no leaf area left, larvae may feed on grape clusters as well. Defoliation can result in sunburn of the fruit and quality loss, as well as reducing reserves for the next year's crop. WGLS overwinters as a pupa under the bark. Moths emerge in spring. There are three generations per year in the Central Valley and two generations in the cooler coastal regions. Female moths lay eggs in clusters on the underside of grape leaves. After hatching, the larvae feed on the leaf underside. When mature, larvae crawl under the loose bark or under ground litter to pupate.

Grape Mealybug (GM) and Vine Mealybug (VM)

Mealybugs can damage grapes by feeding on leaves and by contaminating clusters with honeydew, which supports the growth of black sooty mold. In addition, all mealybugs tested have been shown to vector leafroll viruses. Feeding by mealybugs can be severe enough to stunt vine growth, but this only commonly occurs with vine mealybug. Cluster contamination by mealybugs is related to variety and pruning method. Mealybugs take advantage of tight clustered varieties, where they are better hidden. The vine mealybug can, potentially, cause far greater damage than the other vineyard mealybugs. By the end of the season, vine mealybugs can be found on the leaves, grape bunches, canes, and roots. The vine mealybug produces far greater amounts of honeydew and may have up to 8 generations per year in the San Joaquin Valley (compare with 2-4 for the grape mealybug). Because ants feed on mealybug honeydew, ants play an important role in the development of mealybug pest populations. Ants physically move young mealybugs to desirable feeding areas of the vine in order to collect mealybug honeydew. The spread of mealybugs can be slowed if ant populations are controlled.

Midwest and North Central Regions

In the Midwest and North Central Regions, the primary insect pest for which phosmet and azinphos-methyl are used is the grape berry moth. The most common secondary pest for phosmet is Japanese beetle.

Grape Berry Moth (GBM)

The grape berry moth overwinters in cocoons on the vineyard floor and in adjacent woodlots. The first generation emerges in early summer during pre-bloom. The second generation appears after berry set. A third generation occurs in the South and occasionally in the North. The second generation causes the most damage by tunneling into and feeding on green fruit. A single larva can destroy two to six grapes in a cluster, and several larvae often damage the entire cluster. Additionally, the holes in the fruit made by the larvae often lead to fruit rot problems.

Japanese Beetle

Japanese beetle adults emerge from the soil in June and July and begin feeding on grapes post-bloom. One generation hatches each season. Adults damage grapevines by feeding on leaves only. Damaged leaves have a lacy appearance. Without control, Japanese beetles can completely defoliate an entire vine. Premature leaf loss increases the vine’s susceptibility to winter injury and reduces the vine’s long-term productivity. Japanese beetles are more of a problem in the Midwest and Eastern U.S. than in the Western U.S.

Usage of Phosmet and Azinphos-methyl

Phosmet Usage

The usage of phosmet on wine grapes in California, and the Northwest, North Central, and Midwest Regions is listed in Table 2. On average, an estimated 2% of U.S. grape acreage is treated with phosmet. Two percent of the California acreage is treated with phosmet on average, 9% of the North Central Region, and 62% of the Midwest Region grape acreage is treated with phosmet.

In California, nearly two-thirds of phosmet's total usage on grapes is applied for the control of the omnivorous leafroller, nearly 20% is applied for the control of grape mealybug, and less than 5% is for the control of the Western grape leaf skeletonizer and vine mealybug. In the North Central and Midwest Regions, nearly 45% of phosmet's total usage on grapes is applied for the control of the grape berry moth, and slightly more than one-third is for the control of the Japanese beetle.

Table 2. Usage of Phosmet on U.S., Midwest, North Central, Northwest, and California Grapes [1]

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Total Pounds Applied (1000 pounds)
U.S. [3]	2%	25	34
North Central Region [4]	9%	5	7
Michigan	13%	2	2
New York [5]	10%	--	--
Pennsylvania	20%	3	4
Midwest Region [6]	62%	<1	<1
Indiana	62%	<1	<1
Northwest Region [7]	0%	0	0
California [8]	2%	20	27

1. Source: USDA/NASS Fruit and Nut Chemical Use (1997 and 1999), USDA New York Grape Crop Profile, and CDPR Pesticide Use Reporting database (1998 and 1999).
2. Base acres treated calculated using percent of crop treated estimates from USDA/NASS and bearing acreage from Table 1, unless otherwise noted.
3. U.S. grape usage based on: percent crop treated from USDA/NASS, base acres treated and pounds applied calculated from table.
4. Usage based on three states listed - Michigan, New York, Pennsylvania.
5. Estimates of phosmet usage based on USDA New York Grape Crop Profile.
6. Usage based on Indiana only.
7. States comprising Northwest region: Oregon and Washington. No phosmet usage estimated by USDA/NASS in these states in 1997 and 1999.
8. Usage based on CDPR PUR database (1998 and 1999).

Azinphos-methyl Usage

Table 3 lists the usage of azinphos-methyl on grapes by region and for the major states in each region. On average, less than 1% of the U.S. grape bearing acreage is treated with azinphos-methyl per year, and less than 5,000 pounds of azinphos methyl are applied. Usage of azinphos-methyl on grapes is highest in the North Central Region, where 7% of the grape acreage is treated with azinphos-methyl and 3,000 pounds are applied on average.

In the Midwest Region, nearly 95% of azinphos-methyl's total usage on wine grapes is applied for the control of the grape berry moth.

Table 3. Usage of Azinphos-methyl on Grapes by Region and Major State [1]

Region/ State	Percent of Crop Treated	Base Acres Treated (1000 acres) [2]	Total Pounds Applied (1000 lbs)
U.S.	<1%	<5	<5
North Central Region	7%	4	3
New York [3]	Estimated but not quantified by USDA/NASS		
Michigan	17%	2	1
Pennsylvania	7%	1	1
Midwest Region [4]	–	–	–
Indiana [3]	Estimated but not quantified by USDA/NASS		
Northwest Region [4]			
California	<0.5%	<1	1

1. Source: USDA/NASS Fruit and Nut Chemical Use, 1997 and 1999, CDPR Pesticide Use Reporting Database for California (1998 and 1999).
2. Base acres treated calculated using percent of crop treated estimates and bearing acreage from Table 1.
3. USDA/NASS estimates usage in New York and Indiana, but does not quantify the usage.
4. States comprising Northwest region: Oregon and Washington. States comprising Midwest Region: Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Maryland, Nebraska, Ohio, and West Virginia. Estimates of usage not quantified for these regions.

Azinphos-methyl and Phosmet Use

California

Growers use *Bacillus thuringiensis* (*Bt*) and cryolite to control lepidopterous larvae in vineyards during pre-bloom. After bloom, the growers cannot use cryolite because the wineries restrict the percentage of fluorine in the grapes. Growers will continue to use *Bt* to control lepidopterous larvae until the canopy closes. When the canopy closes it is difficult to get enough *Bt* to the larvae at their susceptible stage to be effective. Phosmet is more effective.

In California, mealybugs are treated with phosmet at the delayed-dormant stage and during summer sprays. The applications potentially interfere with all activities. At delayed-dormant stage activities in the vineyards include pruning, shoot thinning, and shoot removal. During the summer workers would be positioning shoots, pulling leaves to increase air flow, and thinning clusters both for production purposes and to remove diseased bunches.

The second generation of leafrollers and skeletonizers usually occurs mid-July and the third generation occurs in September. Hand harvesting begins in mid-August and goes into October. Additionally, diseased bunches are regularly culled from August through harvest. Phosmet would be used to control both leafrollers and skeletonizers during this time.

Midwest and North Central Regions

The first generation of grape berry moth is generally just prior to bloom; therefore, the first application for grape berry moth occurs just before bloom. Either azinphos-methyl or phosmet could be applied during this time. Within the next 21 days, workers would need to be able to cluster thin, shoot thin, and shoot position. All of these activities are necessary and their timing is critical. Thinning of clusters and shoots must be done from bloom to 2 or 3 weeks post-bloom. Shoot positioning generally starts 2 weeks post-bloom and is repeated in 4 weeks.

There is usually at least one more generation of grape berry moth in mid-July, and occasionally a third generation in August, depending on climatic conditions and locations. An increasing number of growers are using pheromone traps to monitor their insecticide applications to coincide with grape berry moth flight, but many are still relying on a calender spray schedule. For the second generation of grape berry moth, either azinphos-methyl or phosmet could be applied. For the third generation, however, phosmet would most likely be applied due to its shorter REI. The late season application of phosmet may coincide with leaf-pulling activities. During this period, vineyard managers need a short REI to enable workers to enter the vineyard and to complete their manual labor tasks, especially leaf-removal and crop adjustment, to increase crop quality.

Often the choice between applying phosmet or azinphos-methyl depends on whether the Japanese beetle is present. Phosmet will be chosen if the beetle is present since it will control both insect pests. If the Japanese beetle is not present or is at very low levels, then the grower may select azinphos-methyl for grape berry moth control, because azinphos-methyl is not effective in controlling the Japanese beetle.

Alternative Controls for Target Insect Pests

California

In California, the preferred chemical is a mix of *Bt* and cryolite for control of omnivorous leafroller and western grape leaf skeletonizer. This combination works very well. However, cryolite leaves a fluorine residue that will cause grapes to be rejected by the wineries. Additionally, *Bt* is not very effective once the canopy closes. The omnivorous leafroller and the western grape leaf skeletonizer are also controlled by tebufenozide and carbaryl.

Grape and vine mealybugs are most often controlled by chlorpyrifos, imidacloprid, and malathion. Chlorpyrifos is more efficacious to the mealybugs but reduces grape set if applied after the delayed-dormant stage. Imidacloprid has not been very effective in controlling mealybugs in Fresno County.

Midwest and North Central Regions

In the Midwest and North Central Regions, grape berry moth is controlled with carbaryl and methomyl. Additionally, fenpropathrin has just been registered for use on grape berry moth and is reported to be highly effective and lasts for several days. It has become the insecticide of choice for grape berry moth control, but is recommended for only one use during the season. It is expected that in 2 to 3 years mite outbreaks may become a problem as a result of the elimination of mite predators from the application of fenpropathrin.

The Japanese beetle can be controlled with carbaryl and fenpropathrin, both of which are reported as highly effective. However, fenpropathrin should not be used more than once per season, and its use for control of grape berry moth is more critical.

RESTRICTED ENTRY INTERVALS

Phosmet

The current label REI for phosmet on grapes is 2 days. Current label PHI is 14 days east of the Rockies; and 14 days west of the Rockies if rates are 1.33 or more lbs/acre and 7 days if rates are below 1.33 lbs/acre. The phosmet registrant has proposed a

21day restricted entry interval for all activities. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

Azinphos-methyl

Azinphos-methyl has a current label REI of 21 days for cane throwing, cutting, girdling, leaf pulling, bunch thinning, and hand harvest; and 2 or 3 days for all other activities. Please refer to the occupational and residential human health risk assessment on the Agency's website (http://www.epa.gov/pesticides/op) for information concerning the worker risks associated with the restricted entry intervals for this chemical.

IMPACTS RELATED TO OCCUPATIONAL RISK MITIGATION

California

Phosmet's critical use in Fresno County on grapes is for late season control of omnivorous leafrollers. The application of phosmet late season at an REI longer than 14 days will interfere with hand harvesting activities. An REI of longer than 14 days for phosmet would likely result in growers switching to alternatives (i.e., tebufenozide, carbaryl) for late season leafroller control. Potential impacts could include increased cost of alternative chemical control.

Grower and Regional Level Impacts

With a phosmet REI greater than 14 days, grape growers will not continue to use phosmet, and could face increases in costs from using more expensive chemical control late in the season for omnivorous leafroller and Western grape leaf skeletonizer. For the grower in California, per acre net revenues (profits) could fall to $238 per acre - a decline of 7% from current per acre net revenues. State net revenues could fall to $195.1 million from the production of grapes without phosmet - a decline of <1% from current state net revenues. (See General Assumptions, California section.)

North Central and Midwest Regions

Phosmet's critical use in the North Central and Midwest Regions is for late season control of grape berry moth. The application of phosmet late season at an REI longer than 14 days will interfere with hand harvesting activities. An REI of longer than 14 days for phosmet would likely result in growers switching to alternatives (i.e., fenpropathrin, carbaryl) to phosmet for grape berry moth control. Fenpropathrin has excellent control of grape berry moth, however it is typically used at first bloom for grape berry moth, and it is not recommended for use more than once a year for resistance management and the potential for mite outbreaks. Carbaryl is also used for the control of grape berry moth, but generally only for the second generation.

Potential impacts of using the alternatives for the control of grape berry moth are expected to be minor in the short run, due to the effectiveness of the alternatives. However, it is expected that the use of fenpropathrin will lead to mite outbreaks in 2 to 3 years, potentially resulting in yield losses from fruit damage, and increased chemical costs for mite control. Resistance will likely become a problem as well with so few chemicals available for grape berry moth control.

Azinphos-methyl use is critical for mid-season control of grape berry moth. It is also critical for resistance management. An REI of longer than 14 days will interfere with critical activities, such as irrigation, and would force growers to use alternatives pesticides, with cost impacts similar to those mentioned above.

Grower Level Impacts

With phosmet REIs less than or equal to 14 days and azinphos-methyl REIs greater than 14 days, grape growers will not continue the use of azinphos-methyl, and could face increased costs from using more expensive chemicals for mid-season control of grape berry moth. In the North Central and Midwest Regions, grower net revenues could fall to $113 per acre - a decline of 10% from current grower net revenues (see General Assumptions section, North Central and Midwest Regions, Scenario 1).

With the phosmet REI greater than 14 days and azinphos-methyl REIs equal to 14 days, grape growers will not continue to use phosmet, and could face yield losses of 5% to 7% and increased costs from using less effective and more expensive chemicals for late-season control of grape berry moth. In the North Central and Midwest Regions grower net revenues could fall to -$49 to -$122 per acre - a decline of 1.5 to 2 times current grower net revenues (see General Assumptions section, North Central and Midwest Regions, Scenario 2).

With the phosmet REI greater than 14 days and azinphos-methyl REIs greater than 14 days, grape growers will not continue to use phosmet or azinphos-methyl, and could face yield losses of 5% to 7% and increased costs from using less effective and more expensive chemicals for mid- and late-season control of grape berry moth. In the North Central and Midwest Regions, grower net revenues could fall to -$79 to -$152 per acre - a decline of 1 ½ to 2 1/4 times current grower net revenues (see General Assumptions section, North Central and Midwest Regions, Scenario 3).

Regional Level Impacts

With the phosmet REI less than or equal to 14 days and azinphos-methyl REIs greater than 14 days, grape growers will not continue the use of azinphos-methyl and could face increased costs from using more expensive chemicals for mid-season control of grape berry moth. In the North Central and Midwest Regions, where an average of 7% of the grape acreage is treated with azinphos-methyl (and therefore, could be impacted), regional net revenues could fall to $6.94 million and $0.422 million in the North Central Region and Midwest Region, respectively - a decline of 1% from regional net revenues in both regions (see General Assumptions section, North Central and Midwest Regions, Scenario 1).

With the phosmet REI greater than 14 days and azinphos-methyl REIs equal to 14 days, grape growers will not continue to use phosmet, and could face yield losses of 5% to 7% and increased costs from using less effective and more expensive chemicals for late-season control of grape berry moth. In the North Central Region, where 9% of the grape acreage is treated with phosmet (and therefore, could be impacted), regional net revenues could fall to $5.8 to $6.2 million - a decline of 11% to 17% from current regional net revenues. In the Midwest Region, where 62% of the grape acreage is treated with phosmet (and therefore, could be impacted), regional net revenues could fall to -$0.10 million to $0.06 million - a decline of 3/4 to 1 1/4 times current regional net revenues (see General Assumptions section, North Central and Midwest Regions, Scenario 2).

With the phosmet REI greater than 14 days and azinphos-methyl REIs greater than 14 days, grape growers will not continue to use either phosmet or azinphos-methyl, and could face yield losses of 5% to 7% and increased costs from using less effective and more expensive chemicals for mid- and late-season control of grape berry moth. In the North Central Region, where a minimum of 9% of the grape acreage is treated with azinphos-methyl and phosmet (and therefore, could be impacted), regional net revenues could fall to $5.6 to $6 million - a decline of 14% to 20% from current regional net revenues. In the Midwest Region, where a minimum of 62% of the grape acreage is treated with azinphos-methyl and phosmet (and therefore, could be impacted), regional net revenues could fall to -$0.01 million to -$0.16 million - a decline of 1 to 1 ½ times current regional net revenues (see General Assumptions section, North Central and Midwest Regions, Scenario 3).

LIMITATIONS OF THE ANALYSIS

Given the time and resource constraints, the benefits assessment is covering only the short-run impacts to grape growers' net revenues (profits). The analysis is not attempting to measure the potential downstream impacts beyond the grower level of extending the restricted entry intervals (REIs) of azinphos-methyl and phosmet to reduce post application worker exposure. Elements not included in this analysis include changes in cost for distributors, processors, and prices for consumers; impacts to market equilibrium; impacts to the U.S. grape export market; and changes in the channels of trade due to changes in costs of production, prices received at the farm gate level, or increases in foreign imports.

GENERAL ASSUMPTIONS and INPUT VALUES

General Assumptions

The following is a description of the assumptions made to calculate the impacts on grape grower revenues (yield and price), costs, and net revenues (profits) of extending the restricted entry intervals (REIs) for phosmet and azinphos-methyl on grapes, and of the estimates of grape grower revenues, costs, and net revenues as a result of extending the REIs for phosmet and azinphos-methyl on grapes.

Impacts are estimated for one scenario in California (phosmet only) and three scenarios in the North Central and Midwest Regions (azinphos-methyl and phosmet) as defined below. Each scenario represents a different combination of phosmet and azinphos-methyl REIs (California phosmet only), with the assumption made that for any REI longer than 14 days for phosmet, and for azinphos-methyl, grape growers could suffer impacts to their revenues received and/or costs of production. Impacts are measured in terms of the effect of changing azinphos-methyl and phosmet REIs (as set out in each scenario) on per acre grower revenues, costs, and net revenues. The grower level estimates of net revenues are aggregated up to a regional level, taking into account grape acres grown and grape acres treated with azinphos-methyl and phosmet (depending on the scenario) in each region.

The estimates impacts to yield, price, and cost were assumed based on the available information. The analysis is limited to changes in yield, price, and quality for the general category of grapes. The estimates of current production, yield, and price are based on production and price data published in USDA’s Noncitrus Fruits and Nuts 2000 Preliminary Summary. The estimates of current total, variable, and fixed costs are based on enterprise budgets for California grape production (for California), and for Virginia grape production (for the North Central and Midwest Regions).

Assumptions and estimated impacts are provided, by Region (i.e., California, and North Central and Midwest Regions) and by scenario, with separate sections for grower and regional level impacts. An estimate of national level impacts is provided as well. Following the discussion of assumptions and impacts for California and the North Central and Midwest Region is an impact summary section containing two summary tables - one summarizing grower level impacts by scenario, and one summarizing regional level impacts by scenario.

California

Phosmet REI greater than 14 days. Grape growers would no longer use phosmet.

Grower Level Impacts

1. Assume if a grower is using phosmet, they would treat every acre of grapes on their farm with phosmet.

2. Revenue Impact - f(yield, price (quality))

   Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

   A. Assume for California, yield is 7.4 tons per acre, at a price of $450 per ton. Revenues are $3,330 per acre.

   B. Assume no impact on yield or quality. Alternatives (i.e., tebufenozide and carbaryl) will provide effective control of leafrollers and Western grape leaf skeletonizer.

3. Cost Impact

A. Assume costs to be $3,075 per acre ($1,665 per acre variable costs, and $1,410 per acre fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional chemical control to replace the 1 application of phosmet per season for late season omnivorous leafroller and Western grape berry moth control.

1. Assume 1 application of tebufenozide and 1 application of carbaryl. Additional cost of $17 per acre.

D. Assume variable costs increase to $1,682 per acre.

E. Assume total costs increase to $3,092 per acre - an increase of 1%.

4. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $3,330 per acre, costs are $3,075 per acre, and net revenues are $255 per acre.

B. Assume revenues are $3,330, and costs increase to $3,092 per acre. Net revenues equal $238 per acre - a decline of 7%.

C. Assume that total current farm net revenues are $19,380 (an average of 76 acres per farm with net revenues of $255 per acre) in California from grape production.

D. Assume per farm net revenues decline to $18,088 (76 acres per farm with net revenues of $238 per acre) - a decline of 7% - per farm with the loss of phosmet.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

A. Assume that current revenues are equal to $3,330 per acre, costs are $3,075 per acre, and net revenues are $255 per acre. Assume 766,500 grape bearing acres grown in California. Assume net revenues of $195.4 million in California from growing grapes.

B. Assume revenues are $3,330, and costs increase to $3,092 per acre. Net revenues equal $238 per acre.

Assume 2% of California grape acreage treated with phosmet. Assume this is the acreage potentially impacted (15,330 acres). The remaining 761,170 acres will not be impacted.

Assume net revenues of $195.1 million in California - a decline of <1% - in California producing grapes without phosmet.

Impact Summary

Tables 1 and 2 summarize the grower and regional level impacts, respectively, of extending the REI of phosmet on California grapes.

Table 1. Summary of California Grower Level Impacts

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 7.4 tons/A	Prices: $450/A	Current: $3,330/A	Current: $3,075/A	Current: $255/A
Scenario: REIs: Phosmet: > 14 days	Yield loss: None	No Quality Change	No Change	New: $3,092/A	New: $238/A **Net Loss:** $17/A

Table 2. Summary of California Regional Level Impacts

Scenario	Region	Net Revenues
Scenario: REIs: Phosmet: >14 days	California	Current total: $195.4 million New Total: $195.1 million **Net Loss:** $0.3 million

<u>North Central and Midwest Regions</u>

SCENARIO 1

Phosmet REI less than or equal to 14 days and azinphos-methyl REI greater than 14 days. Grape growers would no longer use azinphos-methyl.

Grower Level Impacts

1. Assume if a grower is using phosmet and azinphos-methyl, they would treat every acre of grapes on their farm with phosmet and azinphos-methyl.

2. Revenue Impact - f(yield, price (quality))

    Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

    A. Assume for the North Cental and Midwest Regions, yields are 5.5 tons per acre, at a price of $450 per ton. Revenues are $2,475 per acre.

    B. Assume no impact on yield or quality. Alternatives (i.e., fenpropathrin and carbaryl) will provide effective control of grape berry moth.

3. Cost Impact

    A. Assume costs to be $2,350 per acre ($1,795 per acre in variable costs, and $555 per acre in fixed costs).

    B. Assume fixed costs are unchanged.

    C. Assume a change in variable costs due to additional chemical control to replace the 1 application of azinphos-methyl per season for mid-season grape berry moth control.

        1. Assume an additional 1 application of phosmet and 1 application of carbaryl. Additional cost of $12 per acre.

D. Assume variable costs increase to $1,807 per acre.

E. Assume total costs increase to $2,362 per acre - an increase of 1%.

4. Net Revenue (Profit) Impacts

<u>North Central</u>
A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues are $2,475, and costs increase to $2,362 per acre. Net revenues equal $113 per acre - a decline of 10%.

C. Assume that total current farm net revenues are $2,625 (an average of 21 acres per farm with net revenues of $125 per acre) in the North Central Region from grape production.

D. Assume per farm net revenues decline to $2,373 per acre - a decline of 10% - per farm with the loss of azinphos-methyl.

<u>Midwest Region</u>
A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues are $2,475, and costs increase to $2,362 per acre. Net revenues equal $113 per acre - a decline of 10%.

C. Assume that total current farm net revenues are $625 (an average of 5 acres per farm with net revenues of $125 per acre) in the Midwest Region from grape production.

D. Assume per farm net revenues decline to $565 per acre - a decline of 10% - per farm with the loss of azinphos-methyl.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

<u>North Central Region</u>
A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 56,300 grape bearing acres grown in the North Central Region. Assume net revenues of $7 million in the North Central Region from growing grapes.

B. Assume revenues are $2,475, and costs increase to $2,632 per acre. Net revenues equal $113 per acre.

Assume 7% of the North Central grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (3,941 acres). The remaining 52,359 acres will not be impacted.

Assume net revenues of $6.94 million in the North Central Region - a decline of 1% - in the North Central Region producing grapes without azinphos-methyl.

<u>Midwest Region</u>

A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 3,400 grape bearing acres grown in the Midwest Region. Assume net revenues of $0.425 million in the Midwest Region from growing grapes.

B. Assume revenues are $2,475, and costs increase to $2,632 per acre. Net revenues equal $113 per acre.

Assume 7% of the Midwest grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (238 acres). The remaining 3,162 acres will not be impacted.

Assume net revenues of $0.422 million in the Midwest Region - a decline of 1% - in the Midwest producing grapes without azinphos-methyl.

SCENARIO 2

Phosmet REI more than 14 days and azinphos-methyl REI less than or equal to 14 days. Grape growers would not longer use phosmet.

Grower Level Impacts

1. Assume if a grower is using phosmet and azinphos-methyl, they would treat every acre of grapes on their farm with phosmet and azinphos-methyl.

2. Revenue Impact - f(yield, price (quality))

Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume for the North Cental and Midwest Regions, yields are 5.5 tons per acre, at a price of $450 per ton. Revenues are $2,475 per acre.

B. Assume 5% to 7% yield loss due to lack of effective late season control of grape berry moth. On a per acre level, a 5% to 7% yield loss equates to a reduction in yield of 0.3 tons to 0.4 tons per acre, reducing per acre yield to 5.1 tons to 5.2 tons per acre.

C. Assume no loss in quality due to the loss of phosmet. Therefore, there is no change in end-use market or price. Any total loss from increased pest pressure is captured in the yield loss estimate.

D. Assume per acre revenues decline to $2,295 to $2,340 per acre - a decline of 5% to 7%.

3. Cost Impact

A. Assume costs to be $2,350 per acre ($1,795 per acre in variable costs, and $555 per acre in fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional chemical control to replace the 1application of phosmet per season for late season grape berry moth control.

1. Assume an additional 1 application of fenpropathrin and 1 application of carbaryl. Additional cost of $11 per acre.

2. Assume an additional 1-2 applications of miticides for the control of mite outbreaks resulting from the increased use of fenpropathrin. Additional cost $28 to $56 per acre.

D. Assume variable costs increase $39 to $67 per acre, to $1,834 to $1,862 per acre.

E. Assume total costs increase to $2,389 to $2,417 per acre - an increase of 2% to 3%.

4. Net Revenue (Profit) Impacts

North Central

A. Assume for the North Cental and Midwest Regions revenues are $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,389 to $2,417 per acre. Net revenues equal -$49 to -$122 per acre - a decline of 1 ½ to 2 times current per acre revenues.

C. Assume that total current farm net revenues are $2,625 (an average of 21 acres per farm with net revenues of $125 per acre) in the North Central Region from grape production.

D. Assume per farm net revenues decline to -$1,029 to -$2,562 - a decline of 1 ½ to 2 times current per farm revenues with the loss of phosmet.

Midwest Region

A. Assume for the North Cental and Midwest Regions revenues are $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,389 to $2,417 per acre. Net revenues equal -$49 to -$122 per acre - a decline of 1 ½ to 2 times current per acre net revenues.

C. Assume that total current farm net revenues are $625 (an average of 5 acres per farm with net revenues of $125 per acre) in the Midwest Region from grape production.

D. Assume per farm net revenues decline to -$245 to -$610 - a decline of 1 ½ to 2 times current per farm net revenues with the loss of phosmet.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

North Central Region

A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 56,300 grape bearing acres grown in the North Central Region. Assume net revenues of $7 million in the North Central Region from growing grapes.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,389 to $2,417 per acre. Net revenues equal -$49 to -$122 per acre.

Assume 9% of the North Central grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (5,067 acres). The remaining 51,223 acres will not be impacted.

Assume net revenues of $5.8 to $6.2 million in the North Central Region - a decline of 11% to 17% - in the North Central Region producing grapes without phosmet.

Midwest Region

A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 3,400 grape bearing acres grown in the Midwest Region. Assume net revenues of $0.425 million in the Midwest Region from growing grapes.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,389 to $2,417 per acre. Net revenues equal -$49 to -$122 per acre.

Assume 62% of the Midwest grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (2,108 acres). The remaining 1,292 acres will not be impacted.

Assume net revenues of $0.06 to -$0.10 million in the Midwest Region - a decline of 3/4 to 1 1/4 times current regional profits in the Midwest Region producing grapes without phosmet.

SCENARIO 3

Phosmet REI more than 14 days and azinphos-methyl REI more than 14 days. Grape growers would not longer use phosmet and azinphos-methyl.

Grower Level Impacts

1. Assume if a grower is using phosmet and azinphos-methyl, they would treat every acre of grapes on their farm with phosmet and azinphos-methyl.

2. Revenue Impact - f(yield, price (quality))

Revenues are impacted through changes in yield and/or quality. Yield changes impact the quantity available for sale, and quality changes impact the price received for the quantity sold.

A. Assume for the North Cental and Midwest Regions, yields are 5.5 tons per acre, at a price of $450 per ton. Revenues are $2,475 per acre.

B. Assume 5% to 7% yield loss due to lack of effective late season control of grape berry moth. On a per acre level, a 5% to 7% yield loss equates to a reduction in yield of 0.3 tons to 0.4 tons per acre, reducing per acre yield to 5.1 tons to 5.2 tons per acre.

C. Assume no loss in quality due to the loss of phosmet and azinphos-methyl. Therefore, there is no change in end-use market or price. Any total loss from increased pest pressure is captured in the yield loss estimate.

D. Assume per acre revenues decline to $2,295 to $2,340 per acre - a decline of 5% to 7%.

3. Cost Impact

A. Assume costs to be $2,350 per acre ($1,795 per acre in variable costs, and $555 per acre in fixed costs).

B. Assume fixed costs are unchanged.

C. Assume a change in variable costs due to additional chemical control to replace the 1 application of phosmet and 1 application of azinphos-methyl per season for grape berry moth control.

1. Assume an additional 1 application of fenpropathrin and 2 applications of carbaryl. Additional cost of $13 per acre.

2. Assume an additional 2-3 applications of miticides for the control of mite outbreaks resulting from the increased use of fenpropathrin. Additional cost $56 to $84 per acre.

D. Assume variable costs increase $69 to $97 per acre, to $1,864 to $1,892 per acre.

E. Assume total costs increase to $2,419 to $2,447 per acre - an increase of 3% to 4%.

4. Net Revenue (Profit) Impacts

<u>North Central</u>
A. Assume for the North Cental and Midwest Regions revenues are $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,419 to $2,447 per acre. Net revenues equal -$79 to -$152 per acre - a decline of 1 ½ to 2 1/4 times current per acre net revenues.

C. Assume that total current farm net revenues are $2,625 (an average of 21 acres per farm with net revenues of $125 per acre) in the North Central Region from grape production.

D. Assume per farm net revenues decline to -$1,659 to -$3,192 per acre - a decline of 1 ½ to 2 1/4 times current per farm with the loss of phosmet and azinphos-methyl.

<u>Midwest Region</u>
A. Assume for the North Cental and Midwest Regions revenues are $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,419 to $2,447 per acre. Net revenues equal -$79 to -$152 per acre - a decline of 1 ½ to 2 1/4 times current per acre net revenues.

C. Assume that total current farm net revenues are $625 (an average of 5 acres per farm with net revenues of $125 per acre) in the Midwest Region from grape production.

D. Assume per farm net revenues decline to -$395 to -$760 per acre - a decline of 1 ½ to 2 1/4 times current per farm net revenues with the loss of phosmet and azinphos-methyl.

Regional Level Impacts

1. Net Revenue (Profit) Impacts

<u>North Central Region</u>
A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 56,300 grape bearing acres grown in the North Central Region. Assume net revenues of $7 million in the North Central Region from growing grapes.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,419 to $2,447 per acre. Net revenues equal -$79 to -$152 per acre.

Assume 9% of the North Central grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (5,067 acres). The remaining 51,223 acres will not be impacted.

Assume net revenues of $5.6 to $6 million in the North Central Region - a decline of 14% to 20% - in the North Central Region producing grapes without phosmet and azinphos-methyl.

<u>Midwest Region</u>
A. Assume that current revenues are equal to $2,475 per acre, costs are $2,350 per acre, and net revenues are $125 per acre. Assume 3,400 grape bearing acres grown in the Midwest Region. Assume net revenues of $0.425 million in the Midwest Region from growing grapes.

B. Assume revenues decline to $2,295 to $2,340 per acre, and costs increase to $2,419 to $2,447 per acre. Net revenues equal -$79 to -$152 per acre.

Assume 62% of the Midwest grape acreage treated with azinphos-methyl. Assume this is the acreage potentially impacted (2,108acres). The remaining 1,295 acres will not be impacted.

Assume net revenues of -$0.01 to -$0.160 million in the Midwest Region - a decline of 1 to 1 ½ times current regional net revenues in the Midwest Region producing grapes without phosmet and azinphos-methyl.

Impact Summary

The following two tables summarize, by scenario, the grower and regional impacts of changes to the REIs of azinphos-methyl and phosmet on grapes in the North Central and Midwest Regions.   Tables 3 summarizes the estimated grower level impacts for the North Central and Midwest Regions (estimated to be the same at the grower level). And Tables 4 summarizes regional level impacts in the North Central and Midwest Regions.

Table 3. Summary of North Central and Midwest Region Grower Level Impacts

Scenario	Yield	Quality Impact (Price)	Revenues	Costs	Net Revenues
Current Situation	Current total: 5.5 tons/A	Prices: $450/ton	Current: $2,475/A	Current: $2,350/A	Current: $125/A
1 REIs: AZM: >14 days Phosmet: =/<14 days	Yield loss: None	No Quality Change	No change	New: $2,362/A	New: $113/A **Net Loss:** $12/A
2 REIs: AZM: =/<14 days Phosmet: >14 days	Yield loss: 5-7% Reduces Yield to: Total: 5.1 to 5.2 tons/A	No Quality Change	New: $2,295/A to $2,340/A	New: $2,389/A to $2,417/A	New: -$49/A to - $122/A **Net Loss:** $174/A to $247/A
3 REIs: AZM: >14 days Phosmet: >14 days	Yield loss: 5-7% Reduces Yield to: Total: 5.1 to 5.2 tons/A	No Quality Change	New: $2,295/A to $2,340/A	New: $2,419/A to $2,447/A	New: -$79/A to -$152/A **Net Loss:** $204/A to $277/A

Table 4. Summary of North Central and Midwest Regional Level Impacts

Scenario	Region	Net Revenues
1 REIs: AZM: >14 days Phosmet: =/<14 days	North Central	Current total: $7 million New Total: $6.94 million **Net Loss:** $0.06 million
	Midwest	Current total: $0.425 million New Total: $0.422 million **Net Loss:** $0.003 million
2 REIs: AZM: =/<14 days Phosmet: >14 days	North Central	Current total: $7 million New Total: $5.8 million to $6.2 million **Net Loss:** $0.8 million to $1.2 million
	Midwest	Current: $0.425 million New Total: -$0.1 million to $0.06 million **Net Loss:** $0.365 million to $0.525 million
3 REIs: AZM: >14 days Phosmet: >14 days	North Central	Current total: $7 million New Total: $5.6 million to $6 million **Net Loss:** $1 million to $1.4 million
	Midwest	Current total: $0.425 million New Total: -$0.01 million to -$0.16 million **Net Loss:** $0.435 million to $0.585 million

Input Values

1. The number of farms, yield/acre, average acres per farm, price received per ton, and the value of per acre production by region.

Region/State	Number of Farms	Yield (tons / acre)	Bearing Acres/Farm (acres)	Price ($/ton)	Value of Production ($/acre)
North Central	2,694	5.5 tons	21 acres	$450	$2,475
New York	1,260	--	--	--	--
Michigan	732	--	--	--	--
Pennsylvania	702	--	--	--	--
Midwest	687	5.5 tons	5 acres	$450	$2,475
Arkansas	175	--	--	--	--
Ohio	512	--	--	--	--
California	10,130	7.4 tons	76 acres	$450	$3,330

Sources: USDA 1997 Agricultural Census; USDA 2000 Agricultural Census, USDA Noncitrus Fruits and Nuts 2000 Preliminary Summary.

2. Per Acre Cost of Select Active Ingredients Used on Grapes.

Chemical	Cost of Active Ingredient ($/acre)
Azinphos-methyl	$7
Bt	$9
Carbaryl	$9
Chlorpyrifos	$13
Cryolite	$11
Fenpropathrin	$12
Imidacloprid	$20
Malathion	$6
Methomyl	$13
Phosmet	$10
Propargite (mite control)	$28
Tebufenozide	$18

Source: EPA proprietary usage data.

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